Reviews - General

The implementation of an AIS within the Corps of Engineers will require the conduct of both formal and informal reviews during the various life cycle phases of the project. The number, scope, and formality of the reviews will be determined by the size of the AIS project (program cost), its complexity (e.g., extent of interfaces with other AIS), and -- to a large extent -- the program strategy selected for its implementation (e.g., Grand Design vs. Evolutionary). This appendix provides an overview of the project reviews that may have to be performed before an AIS can be fully deployed to its intended user community. In addition to requirements for formal reviews, this appendix also describes related activites, such as **inspections** and **audits**, that may be necessary as part of the AIS implementation process.

Reviews, inspections, and audits help the Program Manager (PM), Functional Proponent (FP), System Developer (SD), and end user organizations to determine the SD's technical progress against the AIS implementation plan relative to cost and schedule (Note: the SD may be either a government or contractor organization). Reviews, inspections, and audits are risk reduction techniques used to ensure that the delivered AIS will meet the user's needs. They provide a number of benefits to the overall AIS process, including the following:

€ Feedback and clarification to the SD on the interpretation and implementation of requirements,

€ Opportunities for the government acquisition and user

organizations to participate in the user interface design definition and refinement,

€   A method for users to participate in the test and verification program to determine software reliability and compliance with requirements,

€   An effective way to improve the quality of the software production process,

€   The ability, if properly used, to foster process improvements and to motivate better work, and

€   A means for end users, as participants in major milestone reviews, to ensure software supportability prior to turnover (e.g., the design must be analyzed to determine whether maintainability requirements are adequately addressed).

Aside from these benefits, application of the review process must also consider the schedule and cost impacts of injecting extensive review requirements on the AIS process. For larger programs, certain review requirements are mandated by applicable DoD and DA regulations, with very little discretion permitted. However, smaller AIS projects, particularly those in the Class VI category, may permit a less formal or extensive review process to be employed. For AIS projects being implemented under Incremental or Evolutionary Strategies, the review process will be iterative in nature as each developed segment goes through the LCM phases. However, once the initial capability is successfully

deployed, the need for successive, formal reviews will diminish. Possible areas for cost savings in the review/audit process are addressed later in this appendix.

Reviews - Informal

The informal reviews that take place during the evolution of an AIS generally apply to the activities that are performed by the System Developer's organization. As such, these activities primarily occur during the Development Phase of the project. The two basic forms of informal reviews consist of **Walkthroughs** and **Peer Inspections**. The latter is actually more formal than the former. In fact, there are a number of sigificant differences between these two activities, so they should not be viewed as synonymous. Each of these activities is discussed in the following sections.

Reviews - Informal: Walkthroughs

Walkthroughs are considerably less rigid than peer inspections. Walkthroughs can consist of anything from casual peer reviews (e.g., a team of programmers discussing a detailed design approach) to actual management inspections (e.g., a scheduled supervisory review of a programming team's code for a CSU). However, walkthroughs usually do not employ a process that is specifically defined, can be readily repeated, or supports data collection. Thus, walkthroughs do not represent a process that can be effectively studied and improved.

Although useful during AIS design and development, walkthroughs should not be the principal mechanism used during these activities, when there is a call for more disciplined measures.

Reviews - Informal: Peer Inspections

Peer inspections provide a more structured, disciplined approach to software quality control and process improvement. Because these inspections are conducted by the software developer's peers and coworkers, they have a tendency to instill a sense of pride in work well done. They also stimulate an increased attention to detail and carefulness in performance -- factors not necessarily present when work products are self-inspected or tested. *Faults brought to one's attention by one's peers have the tendency to be well-remembered and seldom repeated.* The basic objectives of peer inspections in the AIS implementation process are to:

€ Find errors at the earliest possible point in the AIS development cycle,

€ Ensure that the appropriate parties technically agree on the work to be performed,

€ Verify that the work meets predefined criteria,

€ Fully complete a defined technical task required as part of the AIS project, and

€ Provide data on the AIS development product and the inspection process itself.

The methodology used in software peer inspections is based on a set of structured events, with a system of checklists and predefined roles for participants. These checklists, along with applicable standards used in the

inspection process, must be developed for each type of inspection and tailored to specific AIS project needs. These checklists cover inspection planning, preparation, conduct, exit and reporting criteria. The exit criteria are the DA or Corps-established standards against which inspections measure the completion of an AIS product component (e.g., CSU) at the end of the development activity. The inspection process itself consists of a defined series of steps, such as overview, preparation, inspection, rework, and follow-up. The actual inspected work product may be relatively small -- possibly only 4 to 5 pages of code. The inspection meeting is normally attended by a small number (4 to 5) of co-workers and lasts less than two hours. (Note: Because inspections are rigorous, exacting technical work, defect detection efficiency in meetings over two hours tends to diminish rapidly).

Inspections are conducted by technical personnel for technical personnel. Managers do not normally participate in such inspections, but are provided with the results (problems, impacts, required actions, and dates) to inject into their project planning. A task is assigned to each designated inspector (e.g., moderator, author, reader, tester, etc.) The work product author (e.g., lead programmer) is responsible for removing defects and making corrections. Suggested improvements are provided by other team members during the inspection meeting. The analysis to determine the *cause* of software defects is usually performed by a process action team *after* an inspection is completed, to identify process improvements needed to prevent future occurrences of the same type of defect. More extensive detail on the process of peer inspection can be found in Managing the Software Process by Watts Humphrey (see reference list at the end of this appendix, last item).

It should be noted that effective software inspections require training in the methodology, and there are industry courses available on this subject. Specific information on such training is available from the Air Force Software Technology Support Center (see reference list, next to last item).

Studies performed within DoD and industry indicate that peer inspections are a proven, successful method -- verified and documented -- for removing defects and reducing development costs. While testing concentrates mainly on code, peer inspections can be performed on anything created by the development process that is visible and readable (such as requirements, documentation, designs, test cases, and test plans). Peer inspections are also performed much nearer the point of defect insertion than testing, thus requiring less resources and time for rework. Accordingly, peer inspections more than pay for themselves. Other benefits observed with peer inspections have shown that they:

- € Ensure that associated team members are technically aware of their products and those of each other,

- € Help to build high-performance technical teams,

- € Promote use of the organization's best talent,

- € Provide team members with a sense of achievement and participation,

- € Help the participants develop their skills as *reviewers*,

€   Provide an orderly means to implement a standard of software engineering excellence throughout the development program, and

€   Provide a means of communicating lessons-learned of more experienced engineers to their junior, less experienced peers.

Reviews - Formal

The formal reviews required as part of the AIS implementation process are, for the most part, directed by DoD, DA, and Corps regulations -- particularly for Class I through IV AIS. The designated USACE Milestone Decision Authority (MDA) for Class V and VI AIS efforts has the latitude to define the extent to which formal reviews will be required for a particular AIS. The formal reviews identified in the applicable regulations and guidance documents (see reference list at the end of this appendix) can be generally categorized as **LCM Reviews**, **Management Reviews**, or **Technical Reviews**. An overview of where these types of reviews occur in the AIS life cycle process is illustrated in Figure 13-1. Specific information on each type of review within each of these categories is discussed in the following sections.

Reviews - Formal: LCM Reviews - MDR

The principal formal review specified by DoD for LCM oversight and compliance is the **Milestone Decision Review (MDR)**. A formal MDR, also referred to as simply "milestone review", is required at the end of each major life cycle phase for AIS acquired under DoD Directive 5000.1 and DoD Directive 8120.1, as described in Chapters 2
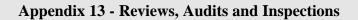
Figure 13-1. Life Cycle Management Phases and AIS Reviews

through 7 of this guide. The requirements for each MDR will vary based on the specific phase, MDA-established criteria, and the size and complexity of the AIS. The particular requirements for preparation and conduct of each MDR are identified at the end of each of the previously specified chapters, with two exceptions. First, there is no formal MDR required at the end of Phase III, Production and Deployment, due to the nature of the transition from this phase into the Operations and Support Phase. Second, the MDR for the Operations and Support Phase is a cyclic activity. The first MDR in this phase is required four (4) years after the Milestone III approval, with subsequent MDRs required every three (3) years thereafter for the life of the AIS.

Reviews - Formal: LCM Reviews - MDR/ MAISRC

A formal LCM review activity that supports the MDR is the **Major Automated Information System Review Council (MAISRC)** program review described in DoD 8120.2-M. This review, essentially an MDR required for Class II and III AIS, will involve extensive preparation for either an Army MAISRC or DoD MAISRC-level program. The MAISRC serves as the senior advisory body to the MDA for large AIS programs subject to review under the procedures of DoD 8120.1. The actual review is preceded by a Program Review Planning Meeting and, later, a Pre-Briefing (dry run activity) 10 days prior to the MAISRC. The specific requirements for a MAISRC-level review are prescribed in DoD 8120.2 and DA PAM 25-3. For DoD, an actual MAISRC review may not be needed if all issues are resolved in pre-meetings and documented, via a System Decision Memorandum (SDM), with appropriate coordination and approval.

**Reviews -
Formal: LCM
Reviews - MDR/
CMAISRC**

Within USACE, the Corps Major Automated Information System Review Council (CMAISRC) serves as the advisory body to the Deputy Commanding General (DCG) in his capacity as the MDA for Class V AIS. Thus, as with the Army MAISRC, the CMAISRC supports the MDR process by ensuring that sufficient progress on a specific AIS has been achieved, and that all requirements have been met to warrant the transition of the AIS into the next life cycle phase. The primary functions of the CMAISRC are to:

€ Review individual milestone decision packages,

€ Identify issues regarding the PM's structure, management, and ability to execute the AIS project, and

€ Determine program disposition upon completion of the CMAISRC review process, and make recommendations to the DCG for signing the System Decision Memorandum.

As with the Army MAISRC, the CMAISRC MDR is preceded by an initial pre-MDR session, more informal, to:

€ Identify and resolve issues and to develop a consensus before the actual CMAISRC review.

€ Provide information to the CMAISRC members prior to the formal CMAISRC review (MDR).

More specific information on the CMAISRC functions, membership, review requirements, and roles and responsibilities is documented in EC 15-1-16, Appendix G.

Reviews - Formal: LCM Reviews - IPRs

An **In-Process Review (IPR)** is a formal activity required by the MDA at key review and decision points that occur within a major LCM phase, or at any time so requested. IPRs will also be used periodically as checkpoints in implementing an AIS during the transition from Production and Deployment Phase to the Operations and Support phase. The specific agenda, format, participation, and response required for these IPRs will be established on a case-by-case basis. For LCM purposes, IPRs are similar to an MDR, but much more narrow in scope. The primary purpose of an LCM IPR, prepared and conducted for the MDA, is to determine:

€ Current program status,

€ Progress since the last decision authority (e.g., MAISRC) review,

€ Program risk and risk reduction measures, and

€ Potential problems that require senior management guidance.

For DoD, IPRs are required under the following conditions:

€ When the period of time between milestones, the AIS program complexity, or the AIS program risks warrant review,

€ When there is a breach of the established AIS program baseline (deviation from the approved baseline - see Appendix 2, *Program Baseline Breach*), or

€ At the discretion of the MDA.

For the Corps, IPRs (which also can mean *In Progress Review*), is considered a formal review for project evaluation under conditions in which a review is warranted outside of the planned reviews, comparable to those stated for DoD. In addition, IPRs in the Corps will be used when there is a change in the approved project scope or structure.

Reviews - Formal: Management Reviews

The other formal reviews that may be required for an AIS implementation consist of both management and technical reviews. MIL-STD-498, the current DoD reguirements document on software development and documentation, refers to the former as **Joint Management Reviews (JMR)**. For these reviews, the System Developer (SD), in coordination with the Program Manager, plans, participates in, and documents the results of each review. The SD/PM proposes locations and dates for the review, which are approved by the organization acquiring the AIS. These reviews should be attended by individuals authorized to make cost and schedule decisions. Generally, management reviews have the following objectives:

€ Keep management informed about project status, directions being taken, technical agreements reached, and overall status of evolving major AIS software components (CSCI level).

€ Resolve issues that could not be resolved at specific joint technical reviews (see the following section).

€ Arrive at agreed-upon mitigation strategies for near- and long-term risks that could not be resolved at joint technical reviews.

€ Identify and resolve management-level issues and risks not raised at joint technical reviews.

€ Obtain commitments and approvals by the acquisition organization needed for timely accomplishment of the AIS project.

As a related type of management review activity, **Program Management Reviews (PMRs)** are often conducted -- on a regularly scheduled basis (e.g., monthly) for larger programs -- for the primary purpose of maintaining regular, open dialogue on project status and issues between the developing and acquiring (or user) organizations. PMRs normally have a pre-published agenda, with minutes prepared and disseminated within one to two weeks after the session. The minutes will specifically document any required action items that surfaced during the review, with established suspense dates. This process provides a means of ensuring follow-up on issues requiring resolution.

Reviews - Formal: Technical Reviews

The applicable DoD and DA guidance documents addressing the subject of reviews vary in how they categorize other type of formal AIS reviews, particularly those that are more technical in nature. For purposes of this guide, the following reviews are generally considered to be technical

reviews, for they are primarily concerned with specific system/subsystem-oriented design, development, test, and verification matters. As with other structured items presented in this guide, the firm requirement for these reviews, including their formality, will be driven by the AIS project, including its size (i.e., class), potential risk, complexity, scope, external impacts (e.g, on other systems), and other programmatic variables. The MDA, in coordination with the PM, SD, and others, will determine which types of reviews are appropriate within the latitude provided by prevailing regulations. Required participation will be driven by the type, objective, and scope of the review (subject matter). For example, the purpose of a Corps technical review may be to review the LCMIS documentation associated with a specific upcoming AIS MDR. For such reviews, HQUSACE/CEIM-L will manage the technical and staff review process (reference EC 15-1-16). An overview of each type of technical review is presented in the following sections, with an indication as to when it occurs within the LCM phases (please refer back to Figure 13-1).

€ **Operational Concept Review (OCR)**. This review, which occurs during the Concept Exploration and Definition Phase, provides an opportunity for the MDA and senior Corps staff to obtain visibility into the evolving conceptual program for the proposed AIS, including potential alternative solutions, and to provide feedback as appropriate. The PM and SD then complete the steps necessary to conclude this phase, including the final MDR.

€ **System Requirements Review (SRR)**. The SRR is a review conducted during the latter stages of the Concept Exploration and Definition Phase to establish, based on the draft Operational

Concept Description (OCD), the preliminary baseline system requirements for the AIS. This review will also address and attempt to resolve existing open issues with the AIS requirements. The key result of this review is a *preliminary* system specification that, with subsequent refinement, will provide the basis for candidate AIS demonstrations in the next phase. DA Pam 73-7, Army Software Test and Evaluation (Final Draft), requires an SRR if it is needed to resolve open issues or address areas of risk identified in the evaluation process.

€ **Test Readiness Review (Prototype) (TRR(P))**. This review provides an opportunity for management and the AIS project team to review, during the Demonstration and Validation Phase, the process to be used in demonstrating and testing prototypes of the proposed AIS. The TRR(P) gives the project group assurance that appropriate and adequate testing will be performed to support validation of a recommended alternative approach to full-scale AIS development.

€ **System Design Review (SDR)**. The SDR, which occurs during the final stages of the Demonstration and Validation Phase, provides a top-level design approach to the AIS, based on the prototype demonstrations and alternatives evaluations performed during this phase. The SDR provides the formal vehicle for validating the recommended design approach, baselining the draft System Specifications, and proceeding to the Milestone II MDR. DA Pam 73-7 applies the same conditions for an SDR as previously noted for the SRR.

€ **Software Specification Review (SSR)**. The SSR is conducted in the early stages of the Development Phase to review and validate specific system-level software requirements analytically derived from the baseline system design approach and their allocation to software components. The SSR authenticates the final Operational Concept Document, as well as the Software Requirements Specifications (SRS) and Interface Requirements Specifications (IRS), establishing the allocated baseline for each CSCI. Depending on the size and scope of the AIS, this activity could be performed as part of the SDR.

€ **Preliminary Design Review (PDR)**. During the Development Phase, a PDR is conducted on the proposed design for each CSCI (or HWCI, for hardware) to assess the degree to which it satisfies the requirements specifications. This assessment establishes the development configuration for the CSCI and supporting databases, as documented in the applicable design specifications. The PDR also serves as the mechanism for reviewing the adequacy of proposed CSCI test plans, CSCI operating requirements, user interaction, system recovery processes, and software supportability. Depending on AIS complexity and previous requirements allocation, a single PDR may be performed for multiple CSCIs. However, DA Pam 73-7 requires a PDR if there are issues and/or risk areas that need to be addressed.

€ **Critical Design Review (CDR)**. The CDR, a significant review conducted during the Development Phase, evaluates the *detailed* design for each CSCI (or HWCI) -- engineering drawings or logic

flows, product specifications, reuse designs, interfaces, etc. -- that evolved from the PDR-approved baseline to ensure compliance with all requirements specifications (SRS/IRS for software). The CDR will also address product testing requirements, such as test procedures and descriptions, and adequacy of proposed test cases. The CDR will review AIS operations and support planning data, including draft system support documentation. *The CDR-baseline approval provides the basis for proceeding to actual code and unit testing*. The same conditions stated in DA Pam 73-7 for PDRs also apply to CDRs.

€ **Test Readiness Review (TRR)**. A TRR is required prior to every formal test conducted on the AIS throughout the development process. A full TRR is more formal than the prototype test review used in the Demonstration and Validation Phase. Most formal TRRs will generally take place during the Development Phase (i.e., TRR(D)) as a precursor to qualification tests. The TRR will address and resolve any issues with:

€ Status of the software test environment,

€ Test cases and test procedures to be used for the CSCI Qualification Test or the System Qualification Test,

€ Status of the software components to be tested, including results of the latest informal tests, and

€ Status of test and system support documentation.

Formal TRRs will be established at appropriate dates prior to execution of all formal AIS tests to ensure that any required test preparation actions are accomplished in sufficient time to conduct the required tests. This process is necessary for both developmental test reviews (DTRR) and operational test reviews (OTRR).

System Qualification Review (SQR). The SQR is conducted as a formal review of the results of formal system-level testing of the AIS. The SQR is normally associated with the System Qualification Test performed during the Development Phase. In some DoD and service publications, the SQR is also referred to as a Functional Qualification Review (FQR). The SQR will assess the results of each category of testing against the pre-established criteria to determine the degree to which the test results are satisfactory, or how much additional testing will be required. This latter activity will involve senior management participation due to the potential cost and schedule impacts on the program. The criticality of this review requires that all decisions be fully documented and that any directed product modifications and retest actions are duly executed. Although not specifically identified in current guidance documentation, a form of an SQR should be conducted after the conclusion of Government Developmental Tests, including IV&V testing, as well as after all operational testing, including the final Software Acceptance Test (see Chapter 5).

System Post-deployment Review (SPR). The SPR, established in DA Pam 73-7, is a review (one or more, as necessary) conducted during the Operations and Support Phase as part of Post Deployment Software Support (PDSS). The primary objective of an SPR is to determine how

well the AIS is functioning in the operational arena. DA recommends that the PM conduct the first SPR approximately six months after site installation is completed. The SPR should assess:

€ How well the operational system is satisfying user requirements in meeting the stated mission, and

€ The degree to which the system operates as the user expects and provides the services expected.

The SPR results will be used by the PM, the AIS Operations Manager (OM), and senior Corps management to identify problem areas and develop changes that will improve system performance and usability.

Review Types - Other

In addition to these specific formal reviews, there are other formally structured activities during the life of an AIS that will require joint participation for identifying and resolving programmatic needs. These activities include the AIS requirement review activities of the Configuration Control Board (CCB) for Engineering Change Proposals (ECPs) (see Appendix 19). The use of IPRs is also applicable at various times across LCM phases, including Operations and Support, such as management review of progress on a pending system enhancement. For major AIS in development that involve multiple units intended for Corps-wide deployment, a Production Readiness Review (PRR) may be required (see MIL-STD-1521B).

Reviews - Audits

As a form of project reviews, there are specifically-defined, formally-conducted audits that are required as part of an AIS implementation. The first is the **Functional Configuration Audit (FCA)**, which is conducted at the completion of formal software testing. As defined in DA Pam 25-6, the FCA formally validates that the development of a CSCI has been satisfactorily completed, and that the CSCI has achieved the performance and functional characteristics specified in the allocated configuration identification, i.e., the requirements for that item as documented in specifications. An FCA may also be performed at a system level to authenticate system-level compliance with specifications. At the conclusion of the Development Phase, a **Physical Configuration Audit (PCA)** is conducted to technically verify that the "as built" CSCI conforms to the technical documentation (e.g., product specifications) that defines the end product. The PCA should be performed prior to the Milestone III MDR (although there may be programmatic exceptions based on program strategy, specific production and deployment plans, or MDA guidance).

Reviews - Cost Considerations

The schedule and cost impacts of performing these various reviews and audits on an AIS project can be significant. Therefore, it is necessary for senior management to exercise judgement and discretion in the imposition of these requirements -- particularly where regulations permit latitude. There are other means of effectively managing this process, with less cost, that may be employed under certain conditions. Such reductions can be accomplished in various ways based on the internal development process, oversight needs of the acquiring organization, the program strategy being employed, the software maintenance concept, degree of user training, and

operational support requirements. Alternatives to formal reviews can include:

€ Increased use of Technical Interchange Meetings (TIMs) to resolve technical issues,

€ Monitoring development status and technical data through *on-line access* to the developer's process and quality database,

€ Reviewing progress and quality metrics at periodic intervals, and
€ Use of available tools to support Corps reviews and analysis of AIS design, implementation, and test data.

Another option for larger, contractor-developed AIS projects -- collocating Corps personnel on site with the developer -- builds a cohesive government/industry team with a common goal of quality and economy. These on-site teams can aid in reducing formal reviews by witnessing test demonstrations to verify progress and development capabilities, and to resolve user interface issues on the spot. With technology currently available in the Corps, another cost-saving option for interactive reviews is the use of *electronic meetings*, employing such media as videoteleconferencing and on-line collaborative work environments (e.g., LotusNotes, electronic white boards, etc.). Table 13-1 provides a summary of possible alternatives to the traditional reviews and audits.

Traditional Requirement	Possible Alternatives

Large formal reviews (ineffective forum for resolving technical issues.)	€ Use on-site representatives to attend informal reviews; € Resolve issues through TIMs, with technical and management support as needed. € Conduct formal PDR/CDRs attended by small group of technical experts and managers to resolve issues from TIMs.
Formal reviews used for presentation of technical progress.	€ Access contractor's development environment (e.g., CM data, requirement traceability matrices, and problem reports) and management tools for plans and status tracking via on-site terminal or dial-in access. € Participate in periodic demonstrations with predefined contractual pass/fail criteria.
Formal Functional Configuration Audit (FCA) and Physical Configuration Audit (PCA) conducted.	€ Substitute continuous monitoring of CM and QA processes for FCA. € Reduce software PCA scope

Table 13-1. Cost Saving Alternatives to Formal Reviews and Audits

Key References - Appendix 13

The following key references were either cited in this appendix, or are directly related to the subject matter discussed in the appendix:

€ DoD Instruction 8120.2, Automated Information System (AIS) Life Cycle Management (LCM) Process, Review, and Milestone Approval Procedures.

€ DoD 8120.2-M, Interim Management Guidance on Conducting Automated Information System (AIS) Life-Cycle Management (LCM)

€ AR 25-3, The Army Information Resources Management Program - Army Life Cycle Management of Information Systems

€ DA Pam 25-3, Procedures for Life Cycle Management of Information Systems

€ DA Pam 25-6, Configuration Management for Automated Information Systems (AIS)

€ DA Pam 73-1, Army Test and Evaluation, Parts One through Five.

€ DA Pam 73-7, Army Software Test and Evaluation (Final Draft)

€ HQDA, SAIS-AE Decision Memorandum, Changes to the Army MAISRC Process and LOI, 26 July 1995.

€ MIL-STD-498, DoD Software Development and Documentation

€ MIL-STD-1521B, Reviews and Audits for Systems, Equipments, and Computer Software

€ EC 15-1-16, Information Resources Management (IRM) Committees

€ Guidelines for Successful Acquisition and Management of Software Intensive Systems, Department of the Air Force, Software Technology Support Center (STSC), Vol. 1, Version 1.1. (Note: STSC Customer Service available at (801) 777-8045).

€ Humphrey, Watts S., Managing the Software Process, Addison Wesley Publishing Company, Reading, MA, 1990.

Appendix 13 - Topic Index

THIS PAGE INTENTIONALLY LEFT BLANK